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Morphological and taxonomical studies on Ophioglossales in Japan and the adjacent regions (1) *Botrychium boreale* from Hokkaido

佐橋紀男*:

日本および近隣産ハナヤスリ目の形態学的分類学的研究 (1) 北海道産のタカネハナワラビについて

Materials. On July 4, 1976, a species of *Botrychium* was found by Prof. Matsuji Hara[1] and others, on a somma of Mt. Usuzan, an active volcano in southern part of Hokkaido. Of the three specimens collected there, the one was passed to me by Prof. S. Kurata, Tokyo University. Shortly after that I was also able to borrow the other two specimens (Fig. 1. A, C) from Prof. Hara and investigate these specimens in all. Furthermore, I had a chance to visit the habitat on August 6, 1976, with Prof. Hara and Mr. T. Kashiwagi. Three specimens (Fig. 1. B, E, Fig. 2) were found there growing under a deciduous broad-leaved forest, 600 m above the sea. Above-mentioned six specimens are the materials used in present paper.

Unfortunately, Mt. Usuzan burst into violent eruption on August 7, 1977, and is still active. I am worrying that the state may lead the habitat to extinction.

External features. Plant somewhat stout and fleshy, 14–23 cm tall, glabrous, commonly light-green; phyllomophore 9–17 cm long; sterile frond inserted above the middle or near the summit of the plant, sessile or nearly so, ovate or often triangular in outline, 2.3–6 cm long, 2.3–5 cm wide, bipinnate or subbipinnate (at least toward the base), pinnae 3–5 pairs, with the primary divisions palmately lobed or crenate, acute at the apex; fertile stalk 1.5–3.5 cm long, the fertile spike bipinnate or paniculate, 1.5–5 cm long; sporangia 1 mm in diameter.

From these features the specimens in question are look alike entirely to the specimens in the name of *B. boreale* in some herbaria (Fig. 3. A–D).

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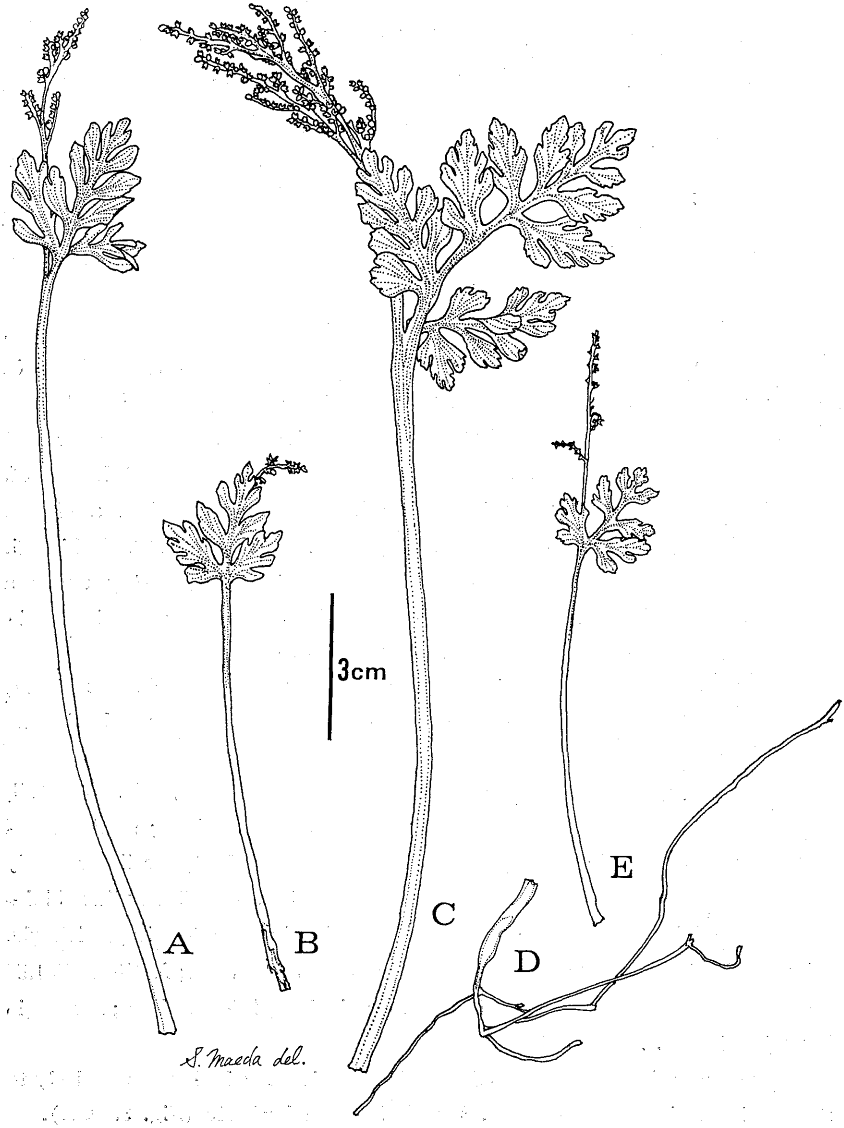

Fig. 1. Sketches of *Botrychium boreale* from Hokkaido. A & C, specimens collected by Prof. Matsuji Hara on July 4, 1976. D, lower part of A. B & E, specimens collected by the author on Aug. 6, 1976.

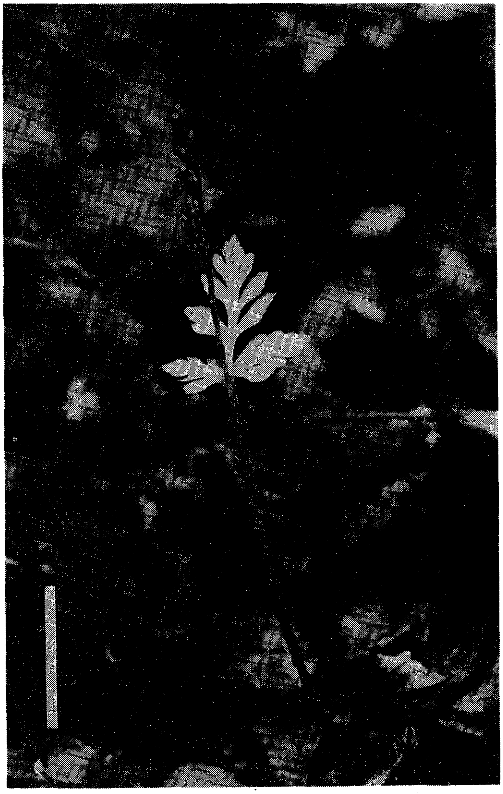

Fig. 2. *Botrychium boreale* growing under a forest on a somma of Mt. Usuzan Hokkaido (Aug. 6, 1976). Scale=2 cm.

Vernation. Bud glabrous, wholly concealed by the base of the phyllomophore. Only the apex of the sterile frond bent over inside the upper segments (Fig. 4. A, B, arrows), in contrast with *B. lunaria*, in which the apex is bent over on the outside (Fig. 4. C, D, arrows).

Vascular type in the phyllomophore. In lower part of the phyllomophore, the vascular bundle is already divided into two equal bundles, each of which faces the xylem (Fig. 5. A, B). About the middle of the phyllomophore, these bundles begin to divide at the center of each bundle (Fig. 5. C). Near the top of the phyllomophore, these bundles are divided respectively into two parts in a tangential plane (Fig. 5. D). This *Double-arc* type (Nozu,

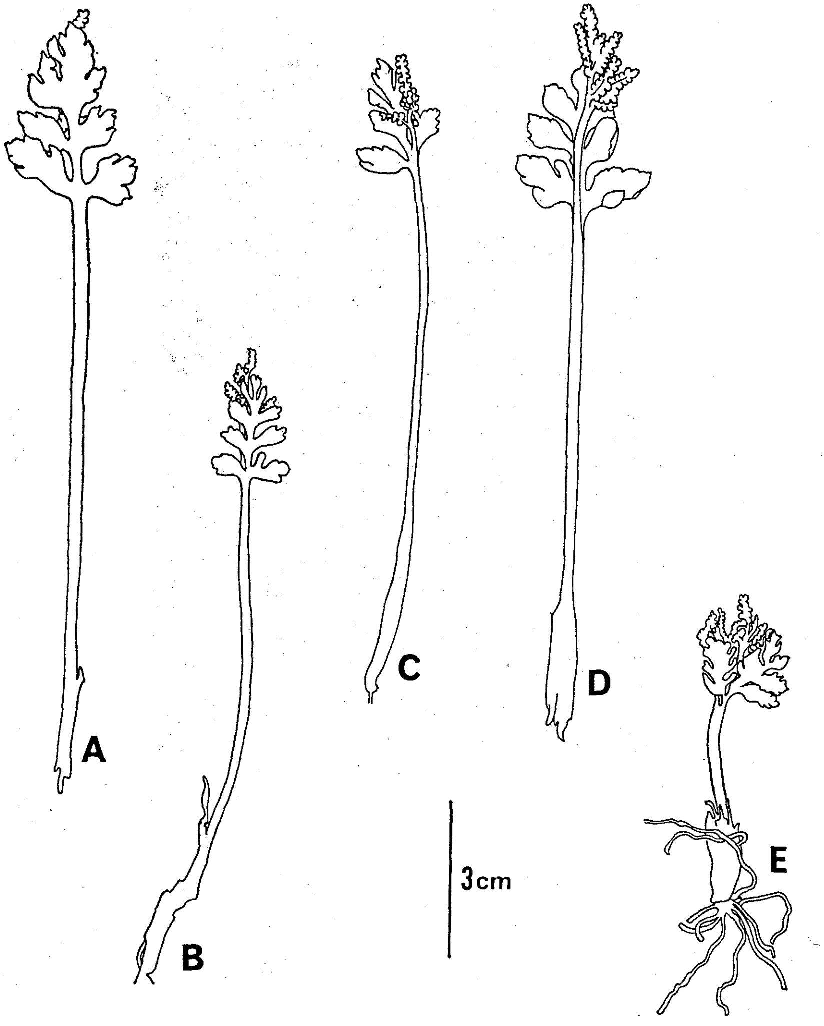

Fig. 3. Sketches of *Botrychium boreale* in the herbarium specimens. A, from Isl. Paramushir, T. Ohashi, Aug. 1932 (KYO). B, from Ust'-Kamchatsk, Kamchatka, I. Namikawa, Jul. 1920 (SAPA). C, from Isl. Shumshu, K. Kishikawa, Jul. 1934 (SAPA). D, from Mt. Paiktusan, T. Ishidoya, Jul. 1931 (KYO). E, from Mt. Paiktusan, no. 251594 (TNS).

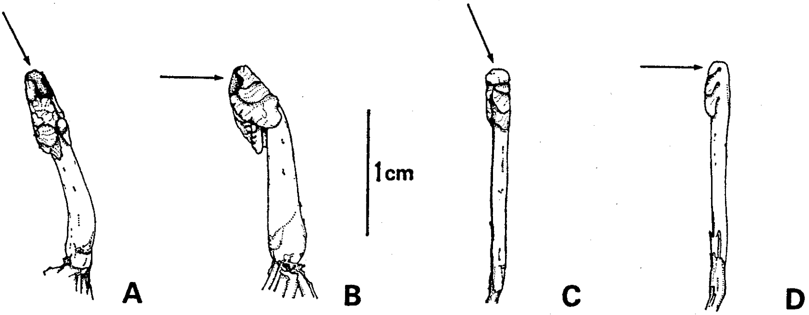

Fig. 4. Buds of *Botrychium boreale* (A, B) and *B. lunaria* (C, D) from Hokkaido. A, front view, arrow points to the apex which is bent over inside of the upper segments. B, side view, from the left, arrow points to the apex of the upper segments. C, front view, arrow points to the apex which is bent over on the outside of the upper segments. D, side view, from the left, arrow points to the apex of the upper segments.

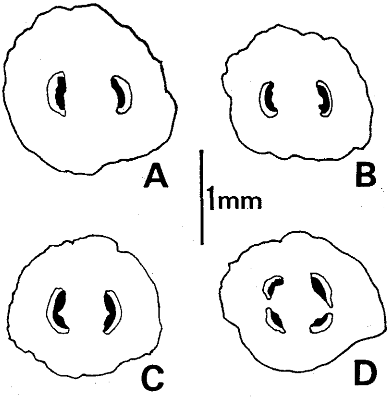

Fig. 5. Serial sections of the phyllomophore of *Botrychium boreale* from Hokkaido. A & B, showing double-arc bundles in the lower part of the phyllomophore. C, each bundle is contracted at the center in the middle of the phyllomophore. D, each bundle separates into two in a tangential plane near the top of the phyllomophore.

1950) of vascular bundles are found by Chrysler (1945) in *B. lunaria*, *B. boreale*, *B. lanceolatum*, and some other species of *Botrychium*.

Spore morphology. Spores are tetrahedral, trilete, often somewhat irregular in outline. The polar view is rounded triangular to often subtriangular (Fig. 6. A, C; Pl. I. A, E). The distal part is hemispherical to often conical and the proximal part is convex to flat in equatorial view. Average size in polar diameter×equatorial diameter of spores is 32×38 μm, ranging 30–34×35–42 μm. At least 30 grains were measured. The laesura arms are about 15 μm long and range from 11 μm to 19 μm, being up to 3 μm tall at the proximal pole. The arms are slender and often undulated (Fig. 6. C; Pl. I. E). The exine is about 2.5 μm thick, including sculptures which are light-yellow and semitransparent with somewhat large and thick verruca-like projections on the distal face (Fig. 6. A; Pl. I. A). These projections are 3–7 μm broad and up to 2 μm tall. The very fine granules are scattered all over the surface of the spore (Fig. 6. B; Pl. I. C). The sculptures of the contact area are usually condensed with small verrucae (Fig. 6. C; Pl. I. E).

In spore material of *B. boreale* from Isl. Paramushir (no. 135332 in TNS) the spore size variation is small, 30–34×35–40 μm, and the verrucae in the distal face are more or less similar to those of the specimens from Mt. Usuzan. Specimens from Mt. Paiktusan (T. Ishidoya, Jul. 1931, in KYO)

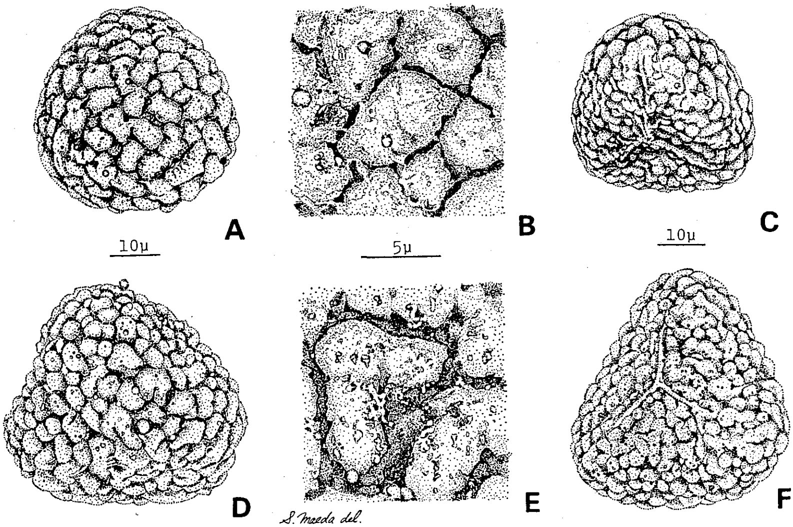

Fig. 6. Spores of *Botrychium boreale* illustrated under the light and electron microscopic observations. A, B, & C, specimens collected from Hokkaido. D, E, & F, specimens collected from Finland. A & D, polar view, distal face. B & E, a part of distal face, showing intermediate form between tuberose and verrucose. C & F, polar view, proximal face.

and Isl. Shumshu (K. Kishikawa, Jul. 1934, in SAPA) have spores similar to those from Mt. Usuzan, measuring 32–38×38–44 μm in size, although the former's spore has larger verrucae and the latter's one has smaller ones than those of the specimens from Mt. Usuzan. On the other hand, the spore size from Finland (no. 1363426 in UC) shows 35.5–42×42–49 μm, but sculptures on the distal and proximal face are similar to those from Mt. Usuzan (Fig. 6. D, E, F; Pl. I. B, D, F).

Spore morphology of *B. boreale* was already investigated by some palynologists (Knox, 1938; Sladkov, 1959; Haeggström & Niemi, 1965; and Erdtman & Sorsa, 1971). The spore size was reported to be a little different by each author, but the surface of the spore is described almost in a verrucae pattern, except Knox (1938) who described it to be reticulate. In general, however, reticulate patterns are found in spores of the subgenus Sceptridium. In 1976 I observed the spores of *B. lunaria* and *B. lanceolatum* by the SEM. In the present study, I found that both the spores of the present specimens from Hokkaido and those of *B. boreale* from some herbaria have intermediate surface patterns between these two species (Fig. 6; Pl. I). Usually, however, *B. boreale* takes after *B. lunaria* more than *B. lanceolatum*.

Conclusions. These results lead to the conclusion that *Botrychium* species in Hokkaido is identical with *B. boreale* (Fries) Milde in Bot. Zeit. **15**: 880. 1857.

According to the distribution map of *B. boreale* by Clausen (1938) and Hultén (1968), it is widely distributed in circumpolar regions. The present habitat is a new record in the temperate region in Japan.

In Japan and the adjacent regions, *B. boreale* was first reported by Nakai (1925, in Bot. Mag. Tokyo **39**: 191) from Mt. Paiktusan in Corea. Formerly he considered it as a new species, *B. subalpinum* Nakai (1918, nom. nud.). Tagawa reported *B. boreale* from Isl. Paramushir, in the Kurile Islands (1956, in Acta Phytotax. Geobot. **16**: 174). Furthermore Nishida (1959) made sure that Nakai's and Tagawa's *B. boreale* are reliable.

In the course of present study, I found the following four specimens of *B. boreale* (Fig. 7) in some herbaria: 1) no. 251594 in TNS, from Mt. Paiktusan in Corea, 2) no. 135332 in TNS, from Isl. Paramushir 3) K. Kishikawa, Jul. 1934, in SAPA, from Isl. Shumshu in the Kurile Isls., and 4) I. Namikawa, Jul. 1920, in SAPA, from Ust'-Kamchatsk, Kamchatka.

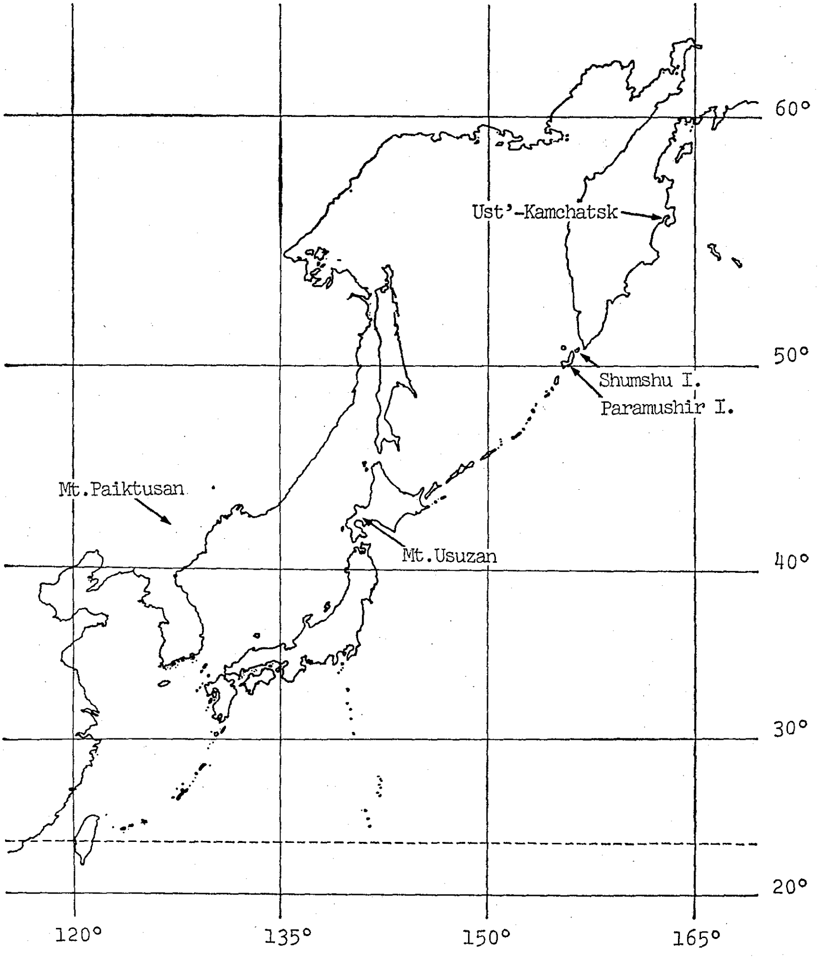

Fig. 7. Distribution map of *Botrychium boreale* in Japan and the adjacent regions drawn basing on the specimens in Japanese herbaria.

My great thanks are due to Emer. Prof. K. Hisauchi and Prof. M. Ikuse, Toho University, Prof. S. Kurata, Tokyo Univ., Emer. Prof. H. Ito, Tokyo Kyoiku University, and Prof. M. Nishida, Chiba University, for their helpful advice, and to Prof. M. Hara and Mr. T. Kashiwagi for the materials of this study. My sincere thanks are also due to the following herbarium curators: KYO, SAPA, TI, TNS, and UC. I am also indebted to Mr. James R. Horrocks for correcting the English of the manuscript, and to Miss. S. Maeda for drawing the figures in the present paper.

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Explanation of Plate I

Plate I. Spores of *Botrychium boreale* Milde: A, C, E. Specimen collected from Hokkaido (herb. in TOHO). B, D, F. Specimen collected from Finland (herb. in UC). A, B. Polar view, distal face, showing triangular outline and verruca-like projections. C, D. A part of distal face, showing intermediate form between tuberose and verrucose. E, F. Polar view, proximal face, showing somewhat undulated laesurae and dense verrucae.

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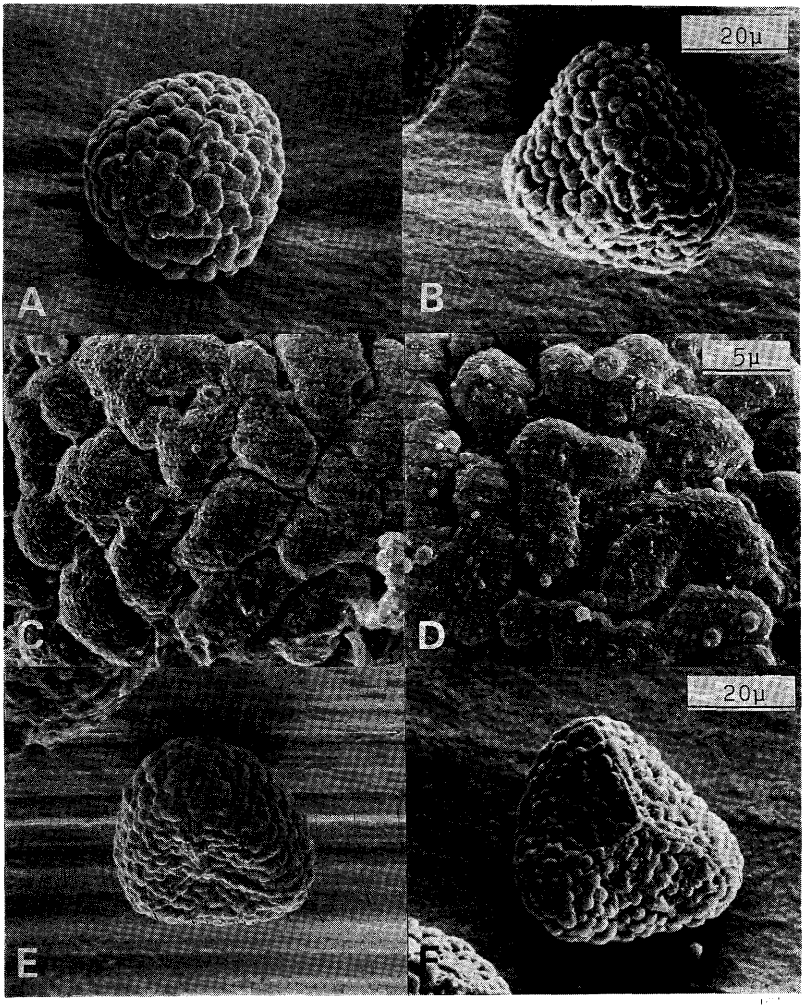
1976年7月4日，北海道の洞爺湖南岸にある有珠山（1977年8月7日の大噴火で有名）の外輪山でヒメハナワラビ属（*Botrychium*）のものと思われるシダ植物3株が発見された。同年8月6日，筆者は発見者の原松次教授の好意により，自生地を訪れ前回のものより小形の3株を発見し採集した。これらについて，植物の外部形態，共通柄内の芽の状態，および維管束の形態，胞子の形態等を観察した結果，このものはタカネハナワラビ *B. boreale* Milde であるとの結論に達した。タカネハナワラビは周極地方に広く分布し，日本近隣では千島列島のパラムシル島などから知られ，中井博士による朝鮮の白頭山が最も南であったが，今回北海道で，しかも比較的低地林床で発見された事実は，分布および生態学上から興味深いことである。なお筆者は今回，国立科学博物館所蔵の TNS. no. 251594 の朝鮮白頭山（長白山）産，TNS. no. 135332 の千島列島パラムシル島産，北海道大学農学部所蔵の千島列島シュムシュ島産（1934年，岸川敬太郎採集）およびウスティカムチャッツク，カムチヤッカ産（1920年，並河功採集）計4点の標本についても調べることができた。

□布施昌一：**シーボルトの日本探検**，この「人間の歴史」の風景．pp. 278，木耳社，東京 1977 XI, 1,300円。近頃は NHK のテレビで「花神」が放映され，そこに傍系ながらシーボルトや‘いね’などが登場しているので御存知の方も多かろう。筆者は，シーボルトを，将軍政治と天皇との関係を二重政体として，正しくみていた最初の外人であったとする立場でシーボルトを見直し「アジサイ *Otaksa* は恋の命名」「シーボルト来日以前の諸風景」「シーボルト来日直前の諸風景」「シーボルト来日時の風景」「シーボルト血の分かれの風景」「シーボルト自身の風景」の六章にわけて書きつづった。学名の記述などに若干の滞りもあるが，シーボルトを中心にした幕府後半の歴史としてみる時，種々の事を改めて学ぶ一つの書としてまた格好の書物といえよう。

（前川文夫）

□Stella ROSS-CRAIG：**Drawings of British Plants**　31 parts and comprehensive index. 1948–1973. Bell & Son, London.　Ross-Craig 女史は，Kew の標本館にあって，1948年から1973年にわたり完行した1517枚の白黒の図版を逐次31の分冊としたものである。その内容については元の園長であった Sir Edward Salisbury が，正確さにおいて科学的であると同時に芸術的であると評された通り，全く立派な文献である。まことに25年もかかった労作で根気の賜である。その点わが岩崎灌園が15年かかって完結した本草図譜を思い出させるものがある。なにはともあれ近頃のインスタントものと異なる。尚，女史は他に良書があるのでカヤツリグサ科とイネ科は除外したと断っている。

（久内清孝）



N. SAHASHI: Spores of *Botrychium*